

***Marasmius tageticolor* and *M. tucumanus* from the Dominican Republic**

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ABSTRACT—Two purple *Marasmius* species from the Dominican Republic are described and illustrated. *Marasmius tageticolor* is characterized by its radially striped pileus, distant lamellae, and elongated spores, and *M. tucumanus* is characterized by its purple to dark red pileus, fragile basidioma, and small spores. Both species were sequenced for the first time and phylogenetically resolved to *Marasmius* sect. *Globulares*, closely related to species of *M. ser. Haematocephali* + *M. ser. Leonini*.

KEY WORDS—*Agaricales*, ITS, *Marasmiaceae*, mushroom, diversity

Introduction

Marasmius tageticolor and *M. tucumanus* are members of *M. sect. Globulares* (Antonín & Noordeloos 2010, Oliveira & al. 2020), characterized by the purple coloration of their pileus surface (Singer 1976). *Marasmius tageticolor* is a relatively well-known species from the Caribbean and northern South America, but there are no complete modern descriptions or publicly available sequences. On the other hand, *M. tucumanus* has been found only once, as the type material from northwestern Argentina that has not been illustrated or sequenced. The aim of this work is to describe and

illustrate both species, evaluate their phylogenetic relationship, and expand their range of distribution to the Dominican Republic.

Materials & methods

Morphological studies

The specimens, which were collected on litter from man-made lowland deciduous woods in the Dominican Republic, were photographed and described macroscopically in situ. The specimens were analyzed macro- and microscopically following the criteria and terminology proposed by Vellinga (1988) and Lodge & al. (2004). Color terminology follows Kornerup & Wanscher (1978). For microscopic analysis, tissue sections were made freehand and mounted in a solution of 5% KOH (v/w) with 1% phloxine aqueous solution. Melzer's reagent (Wright & Albertó 2002) was used to verify amyloidity. The microscopic structures were measured directly through a 1000× oil-immersion objective or photographs taken with a Leica EC3 built-in camera using ImageJ software (Schneider & al. 2012). The notation "L" refers to the number of true lamellae (extending from the stipe insertion to the pileus margin) counted at the margin of the pileus. The minimum-maximum interval was provided for the different microscopic structures. For basidiospores, n = number of spores measured, $\bar{x}$ = mean spore length × width, Q = length / width ratio, and $\bar{Qx}$ = mean Q value. The authors of scientific names agree with Index Fungorum (2020), and herbarium acronyms follow Thiers (2020). The collected material was dried at 40 °C and stored in a freezer for a week before being deposited in the Jardín Botánico Nacional Dr. Rafael M. Moscoso (JBSD) and in the Instituto de Botánica del Nordeste herbaria (CTES).

DNA extraction, amplification, sequencing

Genomic DNA was extracted from dried specimens implementing a modified CTAB protocol based on Murray & Thompson (1980). For PCR reactions, we followed the recommended cycling condition by Mullis & Faloona (1987). Primers ITS1F and ITS4 (White & al. 1990, Gardes & Bruns 1993) were employed to amplify the ITS rDNA region. PCR products were checked in 1% agarose gels and positive reactions were sequenced with one or both PCR primers. DNA extraction, amplification, and sequencing were performed by Alvalab (Spain). Sequences were edited using BioEdit 7.2.5 (Hall 1999).

Phylogenetic analysis

The nrITS dataset compiled included our three new sequences and 44 *Marasmius* sequences selected from GenBank based on BLAST results and previous studies (TABLE 1). *Crinipellis zonata* (Peck) Sacc. was used as outgroup (Aime & Phillips-Mora 2005). Sequences were aligned with MAFFT 7 (Katoh & Standley 2013) under the Q-INS-i criteria. The alignment was manually adjusted with MEGA 5 (Tamura & al. 2011). Potential ambiguously aligned ITS1-ITS2 segments were detected and deleted using Gblocks 0.91b (Castresana 2000).

TABLE 1: *Marasmius* and outgroup sequences used in the phylogenetic analyses.
Sequences obtained in this study are in bold.

SPECIES	SERIES	VOUCHER	GENBANK #	REFERENCE
<i>Crinipellis zonata</i>		VPI3355	AY916692	Aime & Phillips-Mora 2005
<i>M. sect. Marasmius</i>				
<i>M. rotalis</i>	<i>Marasmius</i>	JES145	KX149000	Shay & al. 2017
		JES141	KX148999	Shay & al. 2017
<i>M. cf. subruforotula</i>	<i>Sicciformes</i>	JES186	KX149017	Shay & al. 2017
		JES192	KX149018	Shay & al. 2017
<i>M. tubulatus</i>	<i>Marasmius</i>	TY5502	FJ431280	Tan & al. 2009
		TY5518	FJ431279	Tan & al. 2009
<i>M. sect. Globulares</i>				
<i>M. maximus</i>	<i>Globulares</i>	KG224	FJ904974	Antonín & al. 2010
		BRNM714571	FJ904977	Antonín & al. 2010
<i>M. nivicola</i>	<i>Globulares</i>	BRNM714575	FJ904972	Antonín & al. 2012
		BRNM714572	FJ904970	Antonín & al. 2010
<i>M. pseudo-purpureostriatus</i>	<i>Globulares</i>	NW286	EU643513	Wannathes & al. 2009
<i>M. purpureostriatus</i>	<i>Globulares</i>	BRNM714566	FJ904978	Antonín & al. 2010
<i>M. corrugatiformis</i>	<i>Atrorubentes</i>	DED8233	KX953757	Shay & al. 2017
		DED8326	KX953756	Shay & al. 2017
<i>M. cystidiatus</i>	<i>Atrorubentes</i>	1672	MH2160421	Sharafudheen & Manimohan 2018
		CAL1669	MH216191	Sharafudheen & Manimohan 2018
<i>M. ochroleucus</i>	<i>Atrorubentes</i>	LE 295978	KF912952	Kiyashko & al. 2014
<i>M. strobiluriformis</i>	<i>Atrorubentes</i>	BRNM714914	GU266263	Antonín & al. 2012
		BRNM714915	GU266264	Antonín & al. 2012
<i>M. bondoi</i>	<i>Haematocephali</i>	NW320	EU935474	Wannathes & al. 2009
<i>M. confertus</i> var. <i>tenuicystidiatus</i>	<i>Haematocephali</i>	BRNM718808	HQ607374	Antonín & al. 2012
<i>M. haematocephalus</i>	<i>Haematocephali</i>	NW434	EU935529	Wannathes & al. 2009
		NW430	EU935535	Wannathes & al. 2009
<i>M. magnus</i>	<i>Haematocephali</i>	ICN179252	KX228848	Magnano & al. 2016
		FLOR55963	KX228846	Magnano & al. 2016
<i>M. siccus</i>	<i>Haematocephali</i>	BRNM552709	HQ607384	Wannathes & al. 2009
		LE295980	KF774130	Kiyashko & al. 2014
<i>M. sullivantii</i>	<i>Haematocephali</i>	MO218479	MK607492	Russell & Grootmyers (unpub.)

SPECIES	SERIES	VOUCHER	GENBANK #	REFERENCE
<i>M. acerosus</i>	<i>Leonini</i>	TYS427	FJ431214	Tan & al. 2009
		TYS458	FJ431213	Tan & al. 2009
<i>M. adhaesus</i>	<i>Leonini</i>	TYS467	FJ431216	Tan & al. 2009
		TYS464	FJ431217	Tan & al. 2009
<i>M. olivascens</i>	<i>Leonini</i>	TYS424	FJ431266	Tan & al. 2009
		TYS426	FJ431265	Tan & al. 2009
<i>M. plicatulus</i>	<i>Leonini</i>	NW439	EU935480	Wannathes & al. 2009
<i>M. tageticolor</i>	<i>Leonini</i>	JBSD130776	MT260146	This paper
		JBSD130775	MT260147	This paper
<i>M. tucumanus</i>	<i>Leonini</i>	JBSD130778	MT260145	This paper
<i>M. dendrosetosus</i>	<i>Spinulosi</i>	JES205	KX148995	Shay & al. 2017
		JES211	KX148996	Shay & al. 2017
<i>M. longisetosus</i>	<i>Spinulosi</i>	JO248	JX424040	Oliveira & al. 2014
<i>M. neotrichotus</i>	<i>Spinulosi</i>	CTES0568167	MF683958	Niveiro & al. 2018
<i>M. nummularius</i>	<i>Spinulosi</i>	NW266	EU935492	Wannathes & al. 2009
		NW396	EU935493	Wannathes & al. 2009
<i>M. paratrichotus</i>	<i>Spinulosi</i>	DED8248	KX953749	Grace & al. 2019
<i>M. trichotus</i>	<i>Spinulosi</i>	NW262	EU935490	Wannathes & al. 2009
		NW263	EU935491	Wannathes & al. 2009

Phylogenetic reconstruction was inferred using Maximum Likelihood (ML) and Bayesian Inference (BI). Maximum likelihood was carried out in RAxML-HPC v.8 (Stamatakis 2014), employing the GTRGAMMA model for the entire dataset. The analyses first implemented 1000 ML independent searches, each one starting from one randomized stepwise addition parsimony tree. Only the best scored ML tree was kept, and node reliability was accessed through nonparametric Bootstrap (BS) pseudoreplicates under the same model, allowing the program to halt bootstrapping automatically using the autoMRE option.

Bayesian Inference was performed in MrBayes 3.2.6 (Ronquist & al. 2012). The evolutionary model for BI was estimated using Akaike Information Criterion (AIC) as implemented in jModelTest2 v.1.6. (Guindon & Gascuel 2003, Darriba & al. 2012). We implemented two independent runs, each one beginning from random trees, with four simultaneous independent chains. A total of 2×10^7 generations was carried out, sampling one tree every 1×10^3 generation. All phylogenetic analyses were conducted via CIPRES Science Gateway (Miller & al. 2010). Both analyses (ML and BI) produced similar topology trees. Only the BI 50% majority-rule consensus tree is shown, indicating support values Bayesian posterior probabilities (BPP) / rapid bootstrapping (BS) of each node. A node is considered strongly supported if it showed a BPP ≥ 0.98 and/or BS $\geq 90\%$; moderate support is indicated by BPP ≥ 0.95 and/or BS $\geq 70\%$.

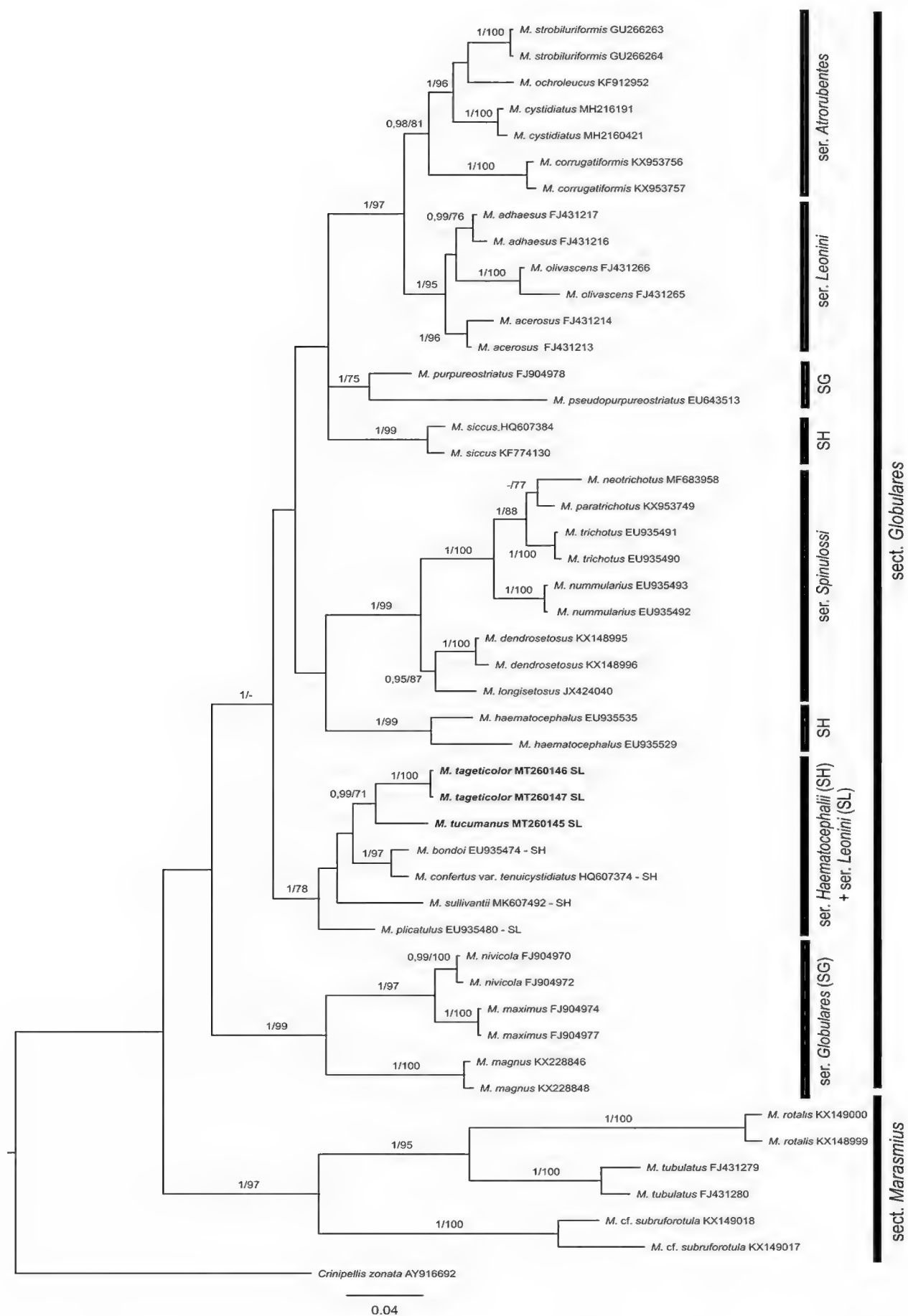


FIG. 1: 50% majority-rule consensus tree from Bayesian Inference based on a dataset of nrITS sequences of *Marasmius* taxa. Bayesian posterior probability BPP ≥ 0.9 , and Bootstrap value, BS $\geq 70\%$ are shown.

Phylogenetic results

The nrITS dataset included 48 sequences from 29 *Marasmius* taxa plus the outgroup, resulting in an alignment with 728 characters, of which 296 are parsimony informative.

Our phylogenetic inference (FIG. 1) recovered two major, well-defined clades: *M. sect. Marasmius* (BPP = 1; BS = 97%) and *M. sect. Globulares* (BPP = 0.93). Within *M. sect. Globulares*, five moderately to highly supported subclades are recognized: *M. ser. Globulares* (BPP = 1; BS = 99%), *M. ser. Atrorubentes* (BPP = 0.98; BS = 81%), *M. ser. Leonini* (BPP = 1; BS = 95%), *M. ser. Spinulosi* (BPP = 1; BS = 99%) and *M. ser. Haematocephali* + *M. ser. Leonini* (BPP = 1; BS = 78%).

Our target species, *M. tageticolor* and *M. tucumanus*, are sisters (BPP = 0.99; BS = 71%) and closely related to *M. bondoi* Wannathes & al. and *M. confertus* var. *tenuicystidiatus* Antonín within the subclade of *M. ser. Haematocephali* + *M. ser. Leonini*.

Taxonomy

Marasmius tageticolor Berk.,

Hooker's J. Bot. Kew Gard. Misc. 8: 136. 1856.

FIGS 2, 3

BASIDIOMATA gregarious, in small groups. PILEUS ≤ 20 mm broad, campanulate to convex when young, then convex to broadly convex, umbonate or with depressed center, sulcate up to the center in all stages of development, with slightly crenate edge; surface striped in pigmentation (the colored stripes correspond to the lamellae and lamellulae lines), center and radial stripes purple (13E8 “deep magenta” to 13F8 “dark magenta”) usually with lighter marginal zones (13C6–7 “greyish magenta”), and white (1A1), pinkish-white (13A2) to pinkish (13A3) between stripes, brown (7E5) to dark brown (7F5) with light yellow (4A4) to light orange (5A4) stripes in dehydrated specimens; dry, subvelutinous, dull. CONTEXT thin, whitish (13A1), odor and taste not distinctive. LAMELLAE free to narrowly adnexed, broadly ventricose, ≤ 5 mm, distant, L = 8–9, white (13A1) at the marginal edge, pink (13A3) to purplish red (13A6) towards the pileus; usually with one series of lamellulae between lamellae. STIPE 15–45 $\times$ 1–1.5 mm, central, cylindrical thin, flared upwards, hollow, surface reddish purple brown (9D7–9E7 “reddish-brown”), lilac (13C7, “purplish red”) towards the apex, blackish (8F4 “greyish brown” to 14F8 “dark purple”) towards the base, glabrous, dry, with a whitish ochre (5B3–4 “greyish orange”) basal mycelial patch. ANNULUS absent. SPORE-PRINT not observed.

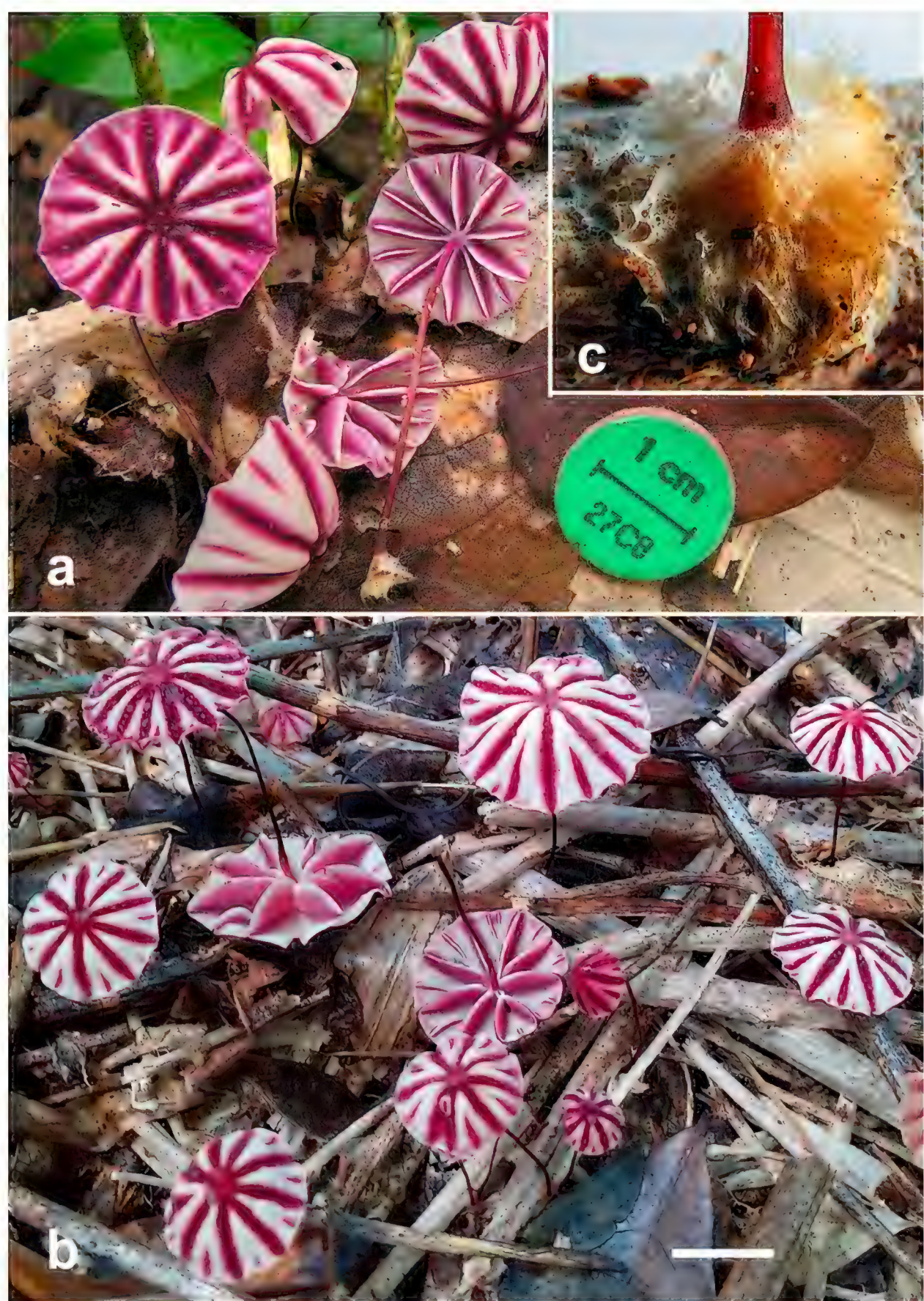


FIG. 2: *Marasmius tageticolor*, macroscopic views: a. JBSD130776; b. JBSD130775; c. Detail of basal mycelial patch. Scale bars: a, b = 10 mm. (Photo by C. Angelini).

BASIDIOSPORES $14\text{--}21.8 \times 3\text{--}4(-4.5) \mu\text{m}$, $x = 18.8 \times 3.4 \mu\text{m}$, $Q = 3.5\text{--}7.1$, $Qx = 5.5$, $n = 25$; oblong, acicular to narrowly clavate, with suprahilar depression, inamyloid, hyaline, smooth, thin-walled. BASIDIA $22\text{--}25 \times 5\text{--}6.5 \mu\text{m}$, clavate, 4-spored, hyaline, thin-walled. BASIDIOLES $15\text{--}25 \times 5\text{--}6.5 \mu\text{m}$, narrowly clavate to fusoid, hyaline, thin-walled. PLEUROCYSTIDIA absent. CHEILOCYSTIDIA in form of *Siccus*-type broom cells, hyaline, with main body claviform, $9\text{--}15 \times 4.5\text{--}6 \mu\text{m}$, setulae $\leq 6 \mu\text{m}$ long, and base $1 \mu\text{m}$ diam. HYMENOPHORAL TRAMA subregular, hyphae $3\text{--}5(-9) \mu\text{m}$ diam., hyaline, thin-walled, dextrinoid. PILEIPELLIS hymeniform, comprising *Siccus*-type broom cells with main body claviform, $9.5\text{--}11.5 \times 5\text{--}7 \mu\text{m}$, setulae $\leq 7 \mu\text{m}$ long, and bases $1.5 \mu\text{m}$ diam.; hyaline in lighter or discolored interlamellar region, stramineous in the pigmented region. PILEOCYSTIDIA absent. STIPITPELLIS a cutis of smooth hyphae, stramineous, appressed, $3\text{--}4 \mu\text{m}$ diam. CAULOCYSTIDIA absent. CLAMP CONNECTIONS present.

ECOLOGY— Forming small groups on dried dicotyledonous twigs and leaves in the litter.

SPECIMENS EXAMINED—DOMINICAN REPUBLIC: PUERTO PLATA PROVINCE, Sosua, PUERTO CHIQUITO, on the litter of an anthropized plain forest with broad-leaved trees, 8/8/2011, leg. C. Angelini 714 (JBSD130775!, GenBank MT260147; CTES!); 5/12/2013, leg. C. Angelini 291 (JBSD130776!, GenBank MT260146; CTES!).

DISTRIBUTION—Originally described from northwestern Amazonas State, Brazil (Berkeley 1856); also known from Venezuela, Mexico (Singer 1976), Panama (Desjardin & Ovrebo 2006), Colombia (Vasco-Palacios & al. 2005), and USA, Trinidad and Tobago, St. Vincent and the Grenadines (GBIF 2020). Newly recorded from the Dominican Republic.

COMMENTS—*Marasmius tageticolor* is characterized by its pileus surface, which is conspicuously radially striped with a purple-red to purple center and lamellar stripes, interspersed with lighter interlamellar regions, distant lamellae, and elongated spores (Singer 1976). The *Siccus*-type broom cells of the pileipellis and the absence of pleurocystidia place this species in *M.* sect. *Globulares* (Antonín & Noordeloos 2010) and *M.* ser. *Leonini* (Singer 1976).

A striped pileus is not a frequent feature in *M.* ser. *Leonini* (Antonín 2007). *Marasmius poecilus* Berk., found in Bolivia, Brazil, and Venezuela, is the closest species and occasionally considered a synonym (Singer 1965). However, Singer (1976) highlighted fine differences to separate these two species, such as the more darkly colored pileus (purplish brown to fulvous with white to yellow stripes), and longer (35–80 mm) stipe in *M. poecilus* (Singer 1976).

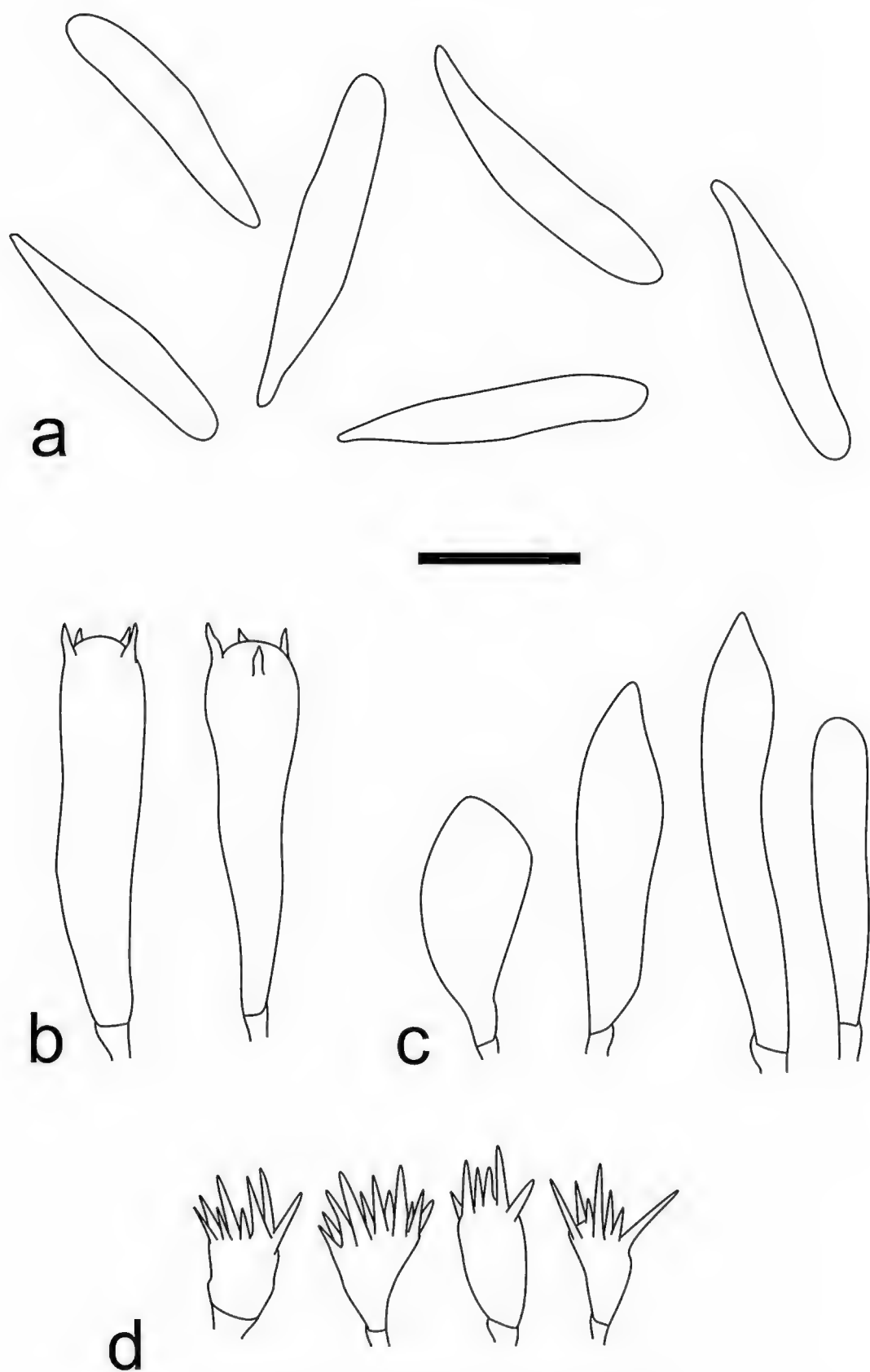


FIG. 3: *Marasmius tageticolor* (JBSD130775).
a. Basidiospores; b. Basidia; c. Basidioles; d. Cheilocystidia. Scale bar = 10 μ m.

Another striped Neotropical species is *M. phaeus* Berk. & M.A. Curtis, but it clearly differs by its dark reddish-brown coloration, lacking a purple hue (Singer 1976). Some African striped taxa such as *M. lilacinoalbus* Beeli var.

lilacinoalbus and *M. lilacinoalbus* var. *lilacinocarmineus* Singer are similar to *M. tageticolor* but differ in their yellowish pileus center and broader spores (4–5 µm; Antonín 2007). *Marasmius striipileus* Antonín has orange brown (6C8) to brown (6D8) tints with paler stripes (Antonín 2004), but differs in the absence of marked streaks with white, yellowish or with pink tints (Antonín 2007).

Berkeley (1856) described *M. tageticolor* (based on dehydrated material and black and white drawings submitted by Spruce from Brazil) as “convex, membranaceous, umbonate, varying from reddish-brown to deep crimson, adorned with from eight to ten yellow rays, very minutely wrinkled... Gills narrow, ventricose, attenuated behind and free, yellow like the rays.” Over a century later, Singer (1965) reported specimens of *M. tageticolor* having brown pileus with deep cream radial stripes and lamellae based on the type material (Spruce 37 K) and additional material from Bolivia (Singer B 1981 LIL) that was later identified as *M. poecilus* (Singer 1976). In that same work and with additional material from Mexico and Venezuela, Singer (1976) described *M. tageticolor* with red pileus and white to ochraceous-whitish stripes and white lamellae. More recently, Desjardin & Ovrebo (2006) described *M. tageticolor* based on specimens from Panama having a light buff pileus surface with beet red (11–12E–F–8) stripes. The specimens analyzed here agree with those described by Desjardin & Ovrebo (2006), but they present some minor differences compared with the protologue (Berkeley 1856) and descriptions made by Singer (1965, 1976), primarily regarding the color of the pileus and lamellae. Pigment variations may be due to different developmental stages, humidity, or observations based on dehydrated materials in which the lamellae and pileus stripes have yellowed. Despite these variables, the remaining characteristics agree with the concept of *M. tageticolor*. Likewise, the pigmentation of the specimens studied here and those described by Desjardin & Ovrebo (2006) are similar to *M. haematocephalus* var. *pseudotageticolor* Singer, with which they could easily be confused, although the *M. haematocephalus* variety differs by the presence of pleurocystidia and the insititious or subinsititious stipe base (Singer & Digilio 1952 as “*M. tageticolor*”; Singer 1959, 1965, 1976).

***Marasmius tucumanus* Singer,**

Lilloa 25: 206. 1952.

FIGS 4, 5

BASIDIOMATA solitary or in small groups. PILEUS ≤15 mm broad, campanulate to convex with papillate center, striate-sulcate up to the center,



FIG. 4: *Marasmius tucumanus*, macroscopic views: a, b, JBSD130777; c, JBSD130778; d. Detail of basal mycelial patch. Scale bars: a–c = 10 mm. (Photo by C. Angelini).

with entire to crenate edge, dark purple (11E7, 11F7 “violet brown”) at the center, lighter towards the margin, from vivid purple red (11A8, “vivid red”) to dark red (11C8); dry, subvelutinous, sometimes pruinose, mostly dull or semi-translucent at the margin. CONTEXT thin, whitish (13A1), odor and taste not distinctive. LAMELLAE free to narrowly adnexed, ventricose, ≤ 2 mm, distant, L = 11–15, white (11A1) at the marginal edge, pink (12A3–4) towards the pileus; with 3–4 series of lamellulae. STIPE 20–40 $\times$ 1.5 mm, central, cylindrical, equal, hollow, surface purple red (10A8 “vivid red”) when young, to violet brown (10F8) when mature, glabrous, dry, with a tomentose, whitish ochre (5B3–4, “greyish orange”) basal mycelial patch. ANNULUS absent. SPORE-PRINT not observed.

BASIDIOSPORES 10–15 $\times$ 3–4.5 μm , $x = 13.2 \times 3.7 \mu\text{m}$, $Q = 3.0\text{--}4.0$, $Qx = 3.5$, $n = 15$; oblong, subclavate, with attenuated suprahilar depression, inamyloid, hyaline, smooth, thin-walled. BASIDIA 22–27 $\times$ 6–7.5 μm , clavate, 4-spored, hyaline, thin-walled. BASIDIOLES 15.5–34.5 $\times$ 4–6 μm , narrowly clavate to fusoid, hyaline, thin-walled. PLEUROCYSTIDIA absent. CHEILOCYSTIDIA in form of *Siccus*-type broom cells, stramineous colored with main body claviform, 11–19 $\times$ 5–9.5 μm , setulae $\leq 7 \mu\text{m}$ long, and base 1.5 μm diam. HYMENOPHORAL TRAMA subregular, hyphae 1.5–3.5 μm diam., thin-walled, dextrinoid. PILEIPELLIS hymeniform, comprising *Siccus*-type broom cells with main body claviform, 15–22 $\times$ 6–7.5 μm , hyaline with $\leq 7 \mu\text{m}$ long setulae and base 1.5 μm diam. with stramineous coloration. PILEOCYSTIDIA absent. STIPITPELLIS an appressed cutis of smooth stramineous hyphae, 3–6 μm diam. CAULOCYSTIDIA absent. CLAMP CONNECTIONS present.

ECOLOGY—Solitary or forming small groups on dried leaves or small twigs of dicotyledonous litter.

SPECIMENS EXAMINED—DOMINICAN REPUBLIC, PUERTO PLATA PROVINCE, Sousa, VERTEDERO, on the litter of an anthropized hill forest with broad-leaved trees, 6/12/2013, leg. C. Angelini 136 (JBSD130777!; CTES!); PUERTO CHIQUITO, on the litter of an anthropized plane forest with broad-leaved trees, 13/12/2014, leg. C. Angelini 503 (JBSD130778!, GenBank MT260145; CTES!). ARGENTINA, TUCUMÁN PROVINCE, Tafí, PARQUE ACONQUIJA, 13/03/1951, leg. R. Singer T1460 (holotype, LIL!).

DISTRIBUTION—Previously known only from the type locality, in Argentina (Singer & Digilio 1952). Newly recorded from the Dominican Republic.

COMMENTS—*Marasmius tucumanus* is characterized by its relatively fragile basidiome, purple to dark red coloration, and spores smaller than those of its most closely related taxa: *M. tageticolor* or *M. haematocephalus* complex (Singer & Digilio 1952). The type specimen (Singer T1460 LIL!) consists of

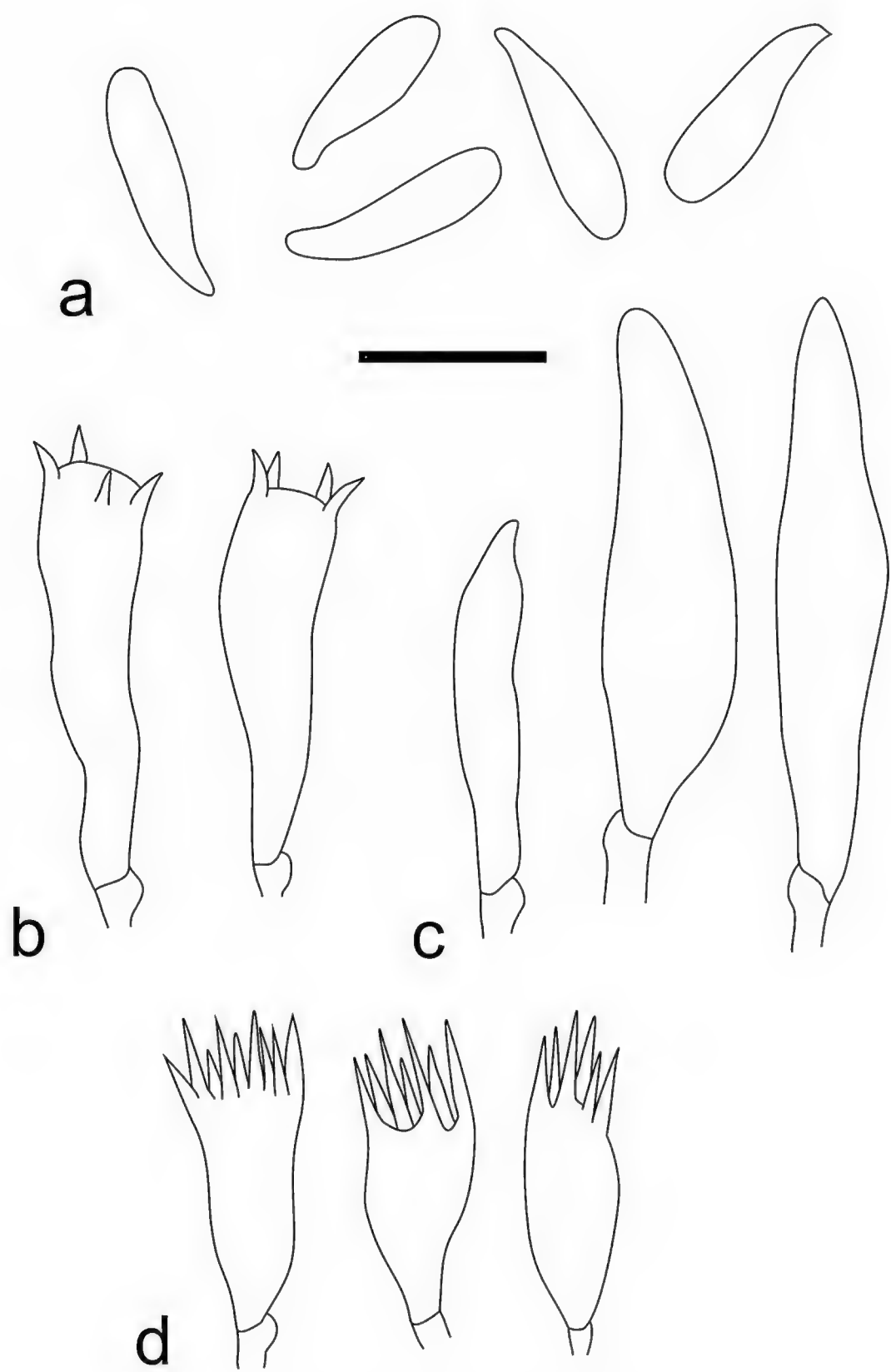


FIG. 5: *Marasmius tucumanus* (JBSD130777).
a. Basidiospores; b. Basidia; c. Basidioles; d. Cheilocystidia. Scale bar = 10 μ m.

a single, well-preserved specimen with macroscopic features that agree with the characters cited in its protologue. Unfortunately, it was not possible to

determine whether the microscopic structures are the same, as destructive sampling of the type specimen is not allowed.

The presence of purple pigment in the pileus is considered an important feature by different authors in delimiting groups of species (Singer 1976, Desjardin & al. 2000, Tan & al. 2009, Wannathes & al. 2009, Shay & al. 2017). Species with similar pigmentation in *M. ser. Leonini* are: 1) *M. tageticolor*, which differs by its peculiar striped pileus and elongated basidiospores (Singer 1976, Desjardin & al. 2000); 2) *M. amazonicus* Henn., known from Bolivia and Brazil, which is distinguished by its larger (16–58 mm) pileus with oval to irregularly rounded buff-colored dots (Oliveira & al. 2008); 3) *M. purpureotinctus* Antonín & P. Roberts, an African species, which differs by its larger (17.5–20 × 4.5–5.7 µm) basidiospores and its pileipellis with thick-walled broom-cells (Antonín 2013); and 4) *M. aratus* Massee [$\equiv$ *M. masseei* Tkalčec & Mešić] from southeastern Asia, which differs by larger spores (22–32 × 3.5–5 µm; Tan & al. 2009). The *M. haematocephalus* complex also resembles *M. tucumanus* in pileal shape and coloration. However, all its taxa have well differentiated pleurocystidia and larger spores (14–25 × 3.5–6 µm; Singer 1976, Tan & al. 2009, Wannathes & al. 2009, Shay & al. 2017).

Discussion

Marasmius tageticolor and *M. tucumanus* are sister species in the phylogenetic tree (FIG. 1) and closely related to some species belonging to the traditional *M. ser. Haematocephali* + *M. ser. Leonini*. This clade has been consistently recovered in different papers (Wannathes & al. 2009, Magnano & al. 2016, Shay & al. 2017, Grace & al. 2019). Among the other species in this clade included in our analyses, *M. bondoi*, *M. confertus* var. *tenuicystidiatus*, and *M. sullivantii* Mont. lack a purple pileus and have pleurocystidia (Antonín 2004, Wannathes & al. 2009), while *M. plicatulus* Peck has more robust basidiomata, a dark reddish brown, minutely velutinous pileus surface, and wider basidiospores (4.8–6.3 µm; Desjardin 1987).

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